U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

RIC 2011

PARENT- An International Collaboration to Explore the NDE Responses of Cracks in Nickel-Alloy Components

Office of Nuclear Regulatory Research

Introduction

The U.S. Nuclear Regulatory Commission (NRC) is finalizing agreements with organizations in Japan, Sweden, Switzerland, South Korea, Finland, and the United States to establish the Program to Assess the Reliability of Emerging Nondestructive Techniques (PARENT). The objectives of PARENT participants are to pool available resources to cooperatively conduct research on emerging nondestructive evaluation (NDE) technologies to address detection and characterization issues for primary water stress-corrosion cracking (PWSCC) in dissimilar metal welds.

Stress-Corrosion Cracking of Nickel Alloy Components

PWSCC has occurred in a wide variety of dissimilar metal welds in the US, Japan, South Korea, and Europe. Detecting PWSCC in dissimilar metal welds can be challenging, as the welds have a large-grained dendritic structure that can scatter or redirect ultrasonic energy. The cracking can be complex and faceted, further complicating detection and sizing. PARENT members will provide specimens, inspection teams, or both. PARENT is a follow-on project to the Program for the Inspection of Nickel Alloy Components.

PARENT Experimental Plans

Open Testing

Open testing will be conducted by teams with experimental and emerging NDE techniques.

The goal of the open testing will be to determine and document the NDE responses for different techniques on a variety of flaws.

Teams participating in the open tests will be given the locations and sizes of the flaws in the test blocks.

Blind Round-Robin Testing

Professional NDE teams using established NDE techniques will be evaluated using closed round-robin tests.

The NDE inspection teams taking part in the blind testing will have no prior knowledge of the flaw locations or sizes.

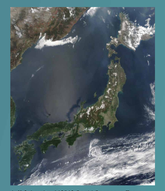
The goals of the blind round-robin testing will be to measure the probability of detection and false call rates for established NDE techniques.

PARENT Members

PARENT is an international program, with participants from organizations in the United States, Japan, Sweden, South Korea, Switzerland, and Finland.

National Climactic Data Center/NOAA Satellite and Information Service

Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC



Jeff Schmaltz, MODIS Rapid Response Team, NASA/GSFC

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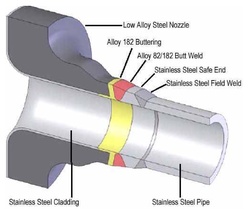

What Is a Dissimilar Metal Weld?

Nickel alloys such as Alloy 600 are used at junctions between carbon steel and austenitic stainless steels. Nickel alloys have linear thermal expansion coefficients that are between the coefficients for carbon and stainless steels.

Components of Interest to PARENT Members

Large-Bore Dissimilar Metal Welds

≈80–90 cm diameter pipe-to-nozzle welds and pipe-to-safe-end welds pwr inlet and outlet nozzle welds

Small-Bore Dissimilar Metal Welds

≈10–40 cm diameter piping and pipe-to-nozzle and pipe-to-safe-end welds

Similar to many piping welds, such as pressurizer surge line welds

Bottom-Mounted Instrumentation Penetrations

Consist of an Alloy 600 penetration tube and an Alloy 182/82 J-groove weld

Nondestructive Testing Techniques of Interest

Experimental Techniques for Open Testing

Advanced Ultrasonic Techniques

- 3D-Synthetic Aperture Focusing Technique Ultrasonic Testing
- Higher Harmonic Ultrasonic Imaging
- Subharmonic Phased Array
- Nonlinear Resonant Ultrasound Spectroscopy

Advanced Electromagnetic Techniques

- Eddy Current Probe Designed for Thick-walled Structures
- Superposition of Eddy Currents
- Near-Field Microwave Method

Commercial Techniques for Blind Testing

- Conventional Ultrasonic Testing
- Phased Array Ultrasonic Testing
- Eddy Current Testing

Path Forward

Open testing is scheduled to begin in the summer of 2011.

Blind round-robin testing will begin in the fall of 2011.

Open and blind tests are expected to take one year each in parallel

The NRC and the Pacific Northwest National Laboratory will produce reports on the open and blind tests describing the major results.